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ABSTRACT

This paper describes a study conducted by Northern Arizona University's Educational Technology faculty regarding training teachers for the integration of technology and the promotion of learner-centered instruction. Participants included traditional pre-service students enrolled in a required "Technology in the Classroom" course and veteran teachers engaged in professional development designed to provide instruction into the integration of technology into the classroom. Instruction modeled the integration of technology from a constructionist perspective, and provided participants the opportunity to engage in activities that utilized the integration of technology. The learning environment was designed to provide instruction to skills and practice exercises utilizing computer applications that could be later used within their teaching practice. Conclusions drawn from the study suggestion that currently learners may not have enough experience learning with the integration of technology to feel comfortable to take responsibility for this type of learner-centered environment. (Contains 10 references.) (AEF)

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# Preparing Teachers To Integrate Technology Using Constructionist Methodology: Don't Teach Me How I Know I Should Teach; Teach Me How I Want To Be Taught

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## Introduction

Currently, many educators suggest that learning can be enhanced if the learning environment includes more interactive, student-centered, and engaging activities where learners construct their understanding rather than more traditional methods of teacher-centered, direct instruction. Inherent is a paradigm shift from more historical teaching methods to an environment where teachers relinquish control and learners accept responsibility for learning. Many agree that this promotes more ownership and stimulates more meaningful learning. However, engaging in such a learning environment presents challenges for both the teacher, who designs, develops, and facilitates this complex environment, and learners who must interact and take responsibility for constructing their understanding.

This paper describes a study conducted by Northern Arizona University's Educational Technology faculty regarding training teachers for the integration of technology and the promotion of learner-centered instruction. Participants included traditional pre-service students enrolled in a required "Technology in the Classroom" course and veteran teachers engaged in professional development designed to provide instruction into the integration of technology into the classroom. Instruction modeled the integration of technology from a constructionist perspective, and provided participants the opportunity to engage in activities that utilized the integration of technology. The learning environment was designed to provide introduction to skills and practice exercises utilizing computer applications that could be later used within their teaching practice.

## Constructivist/Constructionist Approach

What is knowledge? How does one teach this knowledge to others? Looking at educational pedagogy from a very elementary approach, the way one answers the first question will determine how they approach the answer to the second. One can approach the answers from the standpoint that knowledge exists outside of the learner, there are fundamental truths and teaching is helping learners master them. If this is a person's view of knowledge, then teaching usually takes the form of direct instruction and the goals center around students acquiring and repeating factual information. Most printed textbooks are designed for, and many teachers are trained in, this model. Students usually read or are told factual information, and then repeat this information as a part of assessment. This model of knowledge, often referred to as the objectivist model, works well when the objectives to be met result in a type of informational memorization.

One can also view knowledge as something beyond a set of facts, or concepts, or laws that are to be memorized. One can possess a view of knowledge that incorporates an understanding of causes and effects involving ideas and actions that requires the use of higher-order or critical thinking skills. This view does not conceive knowledge as something that exists independent of a knower. Zahorik (1995, pp. 11-12) summarized this view of knowledge in the following way:

> *"Knowledge is constructed by humans.* Knowledge is not a set of facts, concepts, or laws waiting to be discovered. It is not something that exists independent of a knower. Humans create or construct knowledge as they attempt to bring meaning to their experience. Everything that we know, we have made.
> *Knowledge is conjectural and fallible.* Since knowledge is a construction of humans and humans are constantly undergoing new experiences, knowledge can never be stable. The understandings that we invent are always tentative and incomplete.
> *Knowledge grows through exposure.* Understanding becomes deeper and stronger if one tests it against new encounters."

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This model of knowledge is often referred to as the constructivist model. Constructivism's central idea is that human learning is constructed, that learners build new knowledge upon the foundation of previous learning. The constructivist model relies on cognitive psychology for much of its theoretical foundations and has roots in philosophy, sociology, and education. It is important to understand the implications this view of learning has for teaching. The Southwest Educational Development Laboratory News (SEDLetter) in August, 1996 stated:

> "First, teaching cannot be viewed as the transmission of knowledge from enlightened to unenlightened....
> Second, if learning is based on prior knowledge, then teachers must note that knowledge and provide learning environments that exploit inconsistencies between learners' current understandings and the new experiences before them....
> Third, if students must apply their current understandings in new situations in order to build new knowledge, then teachers must engage students in learning, bringing students' current understandings to the forefront. Teachers can ensure that learning experiences incorporate problems that are important to students, not those that are primarily important to teachers and the educational system....
> Fourth, if new knowledge is actively built, then time is needed to build it..."

In educational pedagogy, the reality of the situation is that, teachers find themselves in both the objectivist's camp and the constructivist's camp depending upon the learning objectives of the moment. There are times in our classrooms that our objectives are such that we are actively involved in the "transmission of knowledge from enlightened to unenlightened." There are others times that our learning objectives are such that we do our best to create situations where "students must apply their current understandings in new situations in order to build new knowledge." Teaching is often described as being an art. The art of becoming a master teacher can be seen as an awareness of when to be in one camp or the other and an understanding of how to be effective no matter what camp one is in.

In contemporary education, there has been added to this complexity of teaching and learning the concept of the integration of modern technology. For teachers who are at the moment in the objectivist's camp, technology becomes a tool for a more effective way of transmitting knowledge. In this context, the integration of technology usually takes the form of some type of PowerPoint® presentation or the use of some other multimedia presentation software to supplement teacher-centered instruction. But for those times when a teacher views knowledge from a constructivist perspective, the question then becomes, how can technology be effectively integrated?

In social and developmental psychology, according to von Glasersfeld (1994), constructivist models view the learner as a builder of knowledge, not a passive receptor, but an active constructor. Two important notions orbit around the simple idea of constructed knowledge:

> "The first is that learners construct new understandings using what they already know. There is no *tabula rasa* on which new knowledge is etched. Rather, learners come to learning situations with knowledge gained from previous experience, and that prior knowledge influences what new or modified knowledge they will construct from new learning experiences. The second notion is that learning is active rather than passive. Learners confront their understanding in light of what they encounter in the new learning situation. If what learners encounter is inconsistent with their current understanding, their understanding can change to accommodate new experience. Learners remain active throughout this process: they apply current understandings, note relevant elements in new learning experiences, judge the consistency of prior and emerging knowledge, and based on that judgment, they can modify knowledge (SEDLetter, August, 1996)."

If learning is a constructive process, and instruction must be designed to provide opportunities for such construction, then how can technology be integrated into the instructional processes such that it promotes teachers to teach in "constructivists ways?" The answer may come form a series of research studies described as *constructionism*.

In the 1960's, Seymour Papert and colleagues initiated a research project on how children think and learn and to develop educational approaches and technological tools to help those children learn. From this beginning has evolved a theoretical foundation, which has become known as constructionism. The term constructionism, first

coined by Papert (1991), involves two main tenets. First, it affirms the constructivists' view of learning and asserts that knowledge is not simply transmitted from teacher to student, but actively constructed by the mind of the learner (Kafai and Resnick, 1996). To this constructionism adds the idea that people construct new knowledge with particular effectiveness when they are engaged in constructing *personally meaningful products* (Bruckman & Resnick, 1995). Thus constructionism involves two intertwined types of construction: the construction of knowledge in the context of building personally meaningful products (Kafai and Resnick, 1996). It is through this avenue of "constructing" that technology can be integrated into the instructional processes such that it promotes teachers to teach from a constructivist model.

## Participants

The integration of computer technology into PreK-12 education has been described as one way to promote a learner-centered environment where the computer acts as a tool that possesses a cache' of knowledge and the teacher introduces and moderates ill-structured problems and encourages methods for learner engagement. Described as both constructivist learning theory and constructionist methods, interactive learning activities within this environment include developing meaningful products through student publishing, access to vast resources, engaging in simulations, and utilizing communication systems for peer collaboration.

However, computer technology, specifically productivity software such as MS Office, Claris Works, and the variety of authoring tools are updated generally every other year. In addition, various computer networks are seldom configured the same, which provides a variety of pathways and location names for file management. Although there are many similarities between these tools and learners can develop crossover skills, developing instruction based upon any specific tool or application within any particular system seems unwise. Rather, it seems prudent to promote the learner's understanding of the concepts that are the foundation of the applications and file management systems. Therefore, it has been the goal for these authors, engaged in both new teacher preparation and professional development programs for in-service teachers, to model constructionist principals that utilize the integration of technology in a more student-centered learning environment. It is hoped that by providing this type of learning environment, the learners will enhance their teaching practice by realizing they can use these tools in any environment, regardless of platform, application, or network system.

Participants in this study included traditional pre-service students enrolled in a required "Technology in the Classroom" course and veteran teachers engaged in professional development designed to provide instruction into the integration of technology into the classroom. The learning environment was based upon constructionist principals where both groups of learners were engaged in developing meaningful products that provided an introduction to skills and practice utilizing computer applications that could be later integrated within their teaching practice. The authors also considered themselves participants in this study as their instruction modeled the integration of technology from a constructionist perspective, and provided participants the opportunity to engage in activities that utilized the integration of technology.

### Pre-service Students

All elementary education majors enroll in ETC 447, Technology in the Classroom, as a requirement of their program of studies. It is a three-credit hour course usually taken during the third or fourth year of their teacher education, and before they student teach. Classes are taught in a lab of 22 Motorola Macintosh clones, equipped with printers, scanners, a Proxima display unit, and digital cameras. A network that includes access to CD-ROM software, student and instructor folders, and fast access to the Internet and World Wide Web links these technologies. Eight to eleven sections of the course are offered each semester and summer sessions to accommodate traditional, cohort, and alternative partnership elementary teacher education programs.

ETC 447 has evolved from a skills-based course, in which students individually completed activities by following a manual of scripted instructions, to a classroom simulation of a Multimedia Content Development Company, where student teams collaboratively complete content-centered projects using carefully integrated technology tools. It is our vision to implement an educational technology course that models authentic practice through hands-on activities and social interaction. This teaching strategy enables our students to "do" technology and "be" desktop publishers and multimedia developers and database managers by using technology tools in a supportive learning environment.

### In-service Teachers

The veteran teachers in this study were a group of twenty-one elementary school teachers practicing at a school district in southern Arizona. They were screened and accepted into the eighteen-month technology professional development project with four university educational technology faculty. If accepted through the

application and screening process each participant received an equipped technology cart and software for their classroom in return for their long-term commitment to hands-on participation in technology integration activities and training.

To build cohesion, enhance teamwork, and stimulate ownership of the professional development project a systems approach to learning (Senge, 1990) was taken. The Learning Team, as they later called themselves, was given time during each visit to discuss and plan future topics for curriculum based upon their group decided needs. The educational technology faculty visited on site four times during each of the first two semesters, and then hosted the in-service teachers for a weeklong summer institute on campus. Future plans include four more visits in the 2000 - 2001 academic year to complete the professional development.

The twenty-one teachers participated in strategies similar to those utilized in the pre service ETC 447 model of technology integration. In self-selected small groups they "became" travel specialists or planners of a lecture series and practiced word processing, desktop publishing, database, and spreadsheet skills imbedded in the project. The teachers chose their travel destinations to investigate and promote, or lecture series notable speakers, so that the content was relevant to them. The final product was a group multimedia presentation of their project.

## Data Collection

This paper details a collaborative action research approach to (Oja & Smulyan, 1989) investigating teaching technology integration from a learner-centered constructionist perspective. Both quantitative and qualitative data were collected through self-report instruments, email communications, observations and anecdotal notes of instructional sessions, group meetings and personal interactions. The purpose of an action research approach is to provide a better understanding of the interactive processes and promote the improvement of conditions for the participants of the study. Therefore, data were collected from the role of observer/participant. This provided the opportunity to observe and help support the authors in fostering a better understanding and improve the learning process in this particular study.

Surveys, observations, email communications, anecdotal notes, and personal interactions provided both quantitative and qualitative data that gave a detailed account of learning experience regarding the instructional methods during the classes and professional development program. The qualitative data from observations, email communications, anecdotal notes, and personal interactions provided detail on the participants.

Quantitative data collected in the Center for Excellence in Technology Survey provided basic descriptions of the participating learners of this study. The Center for Excellence in Education Technology Survey is a self-report that provides information (5-point likert scale) regarding the learners' comfort using technology. Information on specific technology is also reported. For example, participants report on their self-efficacy using basic computer skills (i.e. word-processing, email, and CD-ROMs).

In addition, The Stages of Concern about the Innovation Questionnaire developed by Hall, George and Rutherford (1977) was used to measure the professional development participating teachers' process of being selected to be technology innovators for their district. This questionnaire assesses seven hypothesized stages of concern about an innovation that an individual moves through when adopting a process or product innovation, i.e., technology. The seven stages are: (0) Awareness, (1) Informational, (2) Personal, (3) Management, (4) Consequence, (5) Collaboration, and (6) Refocusing. This questionnaire utilizes an eight-point scale of 0, 1 (not true of me now), 2, 3, and 4 (somewhat true of me now), and 5, 6, and 7 (very true of me now). The progression from stage to stage indicates the participants' ideas that go from unrelated concerns about technology usage to the total involvement with technology and its impact on the learning process.

In the first stage, the Awareness stage, little concern about or involvement with the innovation is suggested. The Informational stage, the second stage, shows a general awareness of the innovation and interest in learning more detail about it. In the third stage, the Personal one, the individual is uncertain about the demands of the innovation, his or her role with the innovation and his or her adequacy to meet the innovation's demands. The fourth stage, Management, focuses the attention on the processes and tasks of using the innovation and the best use of information and resources. In the fifth stage, Consequence, the focus is on the impact that the innovation may have on the students' outcomes. Collaboration, the sixth stage, focuses on coordination and cooperation with others regarding the use of the innovation. Finally in the Refocusing stage, the seventh stage, the focus is on exploration of more universal benefits from the innovation, including the use of alternative ideas to the proposed or existing form of innovation.

## Discussion

There were many similarities between both the campus-based, pre-service group and the professional development group in regard to their self-efficacy of using computers. For example, there was no significant difference between the pre-service and the in-service teachers in their self-efficacy reports of computer use. As table 1 indicates, both groups demonstrated a high level of self-efficacy for using computers for general tasks – 4.201176471 and 4.11047619 out of 5.

| | Pre-service Teachers n=34 | In-Service Teachers n=22 |
|---|---|---|
| Mean | 4.201176471 | 4.11047619 |
| Standard Deviation | 0.532528359 | 0.67015279 |

*Table 1. Computer Use Self-Efficacy*

Participants in both groups indicated that they desired less constructionist methods. Interestingly, participants, at times, resisted the more open discovery learning methodology and indicated on several occasions that they would rather be provided with very specific "how to" skill instruction using the computers and software applications.

**The Professional Development Group**

Several participants indicated that they wanted to know how to use the software, become "experts" or "gurus" before they learned how to integrate the technology into their teaching practice. They suggested that learning to use the computer and software was an independent learning objective different from learning how to integrate the technology into the classroom. As one professional development participant commented: "I need to understand how to use this equipment before I can learn how to integrate it into my teaching." Indeed, the professional development group on several occasions requested listed steps for using specific computer applications. This is particularly surprising as members of the professional development group, a) were chosen for the program based on their self-reported technology skills, b) demonstrated generally high self-efficacy for computer use skills, and c) demonstrated a Personal and Management stage at the 80th percentile on The Stages of Concern about the Innovation Questionnaire, suggesting that they have high technology-knowledge of innovating people who had already mastered technology.

The participating teachers were engaged in additional technology training sessions at the same time conducted by various other providers as well. Several individuals indicated that they were receiving step-by-step handouts and worksheets in their other training sessions and asked why they weren't being provided those during this professional development as well.

Indeed, their demand to learn more computer skills continued to the point that their district technology program director made available online skills training for the entire professional development group between the 4th professional development session and the week long summer session, as indicated by this email.

> "I have 20 TEAM members signed up for Teacher Universe. The pre training session is set for Saturday, May 6, 2000 from 8:30 a.m. to noon. I will open up the training to 5 more people today. If you want to view the site before Saturday, go to http://www.teacheruniverse.com See you all Saturday!"

Their desire to have more application skill training was constant through out the professional development training sessions. During a discussion on the project bulletin board about their taking on a specific area to become an expert, as this teacher stated:

> "I also think some of our [professional development group] members are feeling a little computer-deficient, or at least they lack confidence in their own skills. Maybe if we had had some application-based training going on concurrent to our class, it would have been less difficult."

Another teacher may have hit the nail on the head by responding:

> "I think one of the reasons people are uncomfortable choosing an area of "expertise" is the term itself. I consider myself to be a damned fine teacher, but not an "expert." An expert in my mind is someone who knows everything about that topic – someone to whom I can go to for the nitty gritty. I am someone, though, that you could come to for advice on teaching. Maybe we need to consider a different term for 'expert'."

Interestingly, this suggests that in an area such as technology, which changes constantly, individuals may have a difficult time seeing themselves as ever being experts or having enough skills. Certainly the participating teachers of the professional development group demonstrated this. One of the NAU faculty members specifically tried to address this at one of the professional development group planning sessions with the teachers when he

stated; "At what point do you consider yourself an expert? I don't have all of the knowledge. I'm constantly learning new technology skills. I don't have all of the answers; I just have more than you at this point. You need to realize that you also have more knowledge and skills than others, and to them *you are a guru*." Indeed, the topic of "How do we get them to realize that this isn't about learning skills, but rather a shift in the learning paradigm?" was discussed often during project planning meetings by the NAU faculty.

Participants indicated on several occasions that they desired specific skill set instructions because they believed it would be easier to learn a step-by-step process rather than having the skills embedded into a more project-based method. Most interestingly however, during discussions of how they might integrate technology into their classrooms, the stated that they thought using the learner-centered environment (Travel Agency or Lecture Series Experts) that utilized imbedding the computer skills into a constructionist model utilized by the NAU faculty would be an excellent way to teach their students. This was in direct contrast to how they demonstrated, in many ways, that they preferred to be taught technology instruction.

**The University Pre-service Group**

The purpose of providing more learner-centered instruction is to promote greater understanding of the skills and concepts. Students in the university technology course taught by the authors are provided with instruction based upon this constructionist model. Similarly to the professional development group, this group indicated their self-efficacy in basic computer use (m=4.201176471 out of 5, sd=0.532528359), but also demonstrated the desire to learn with greater emphasis on step-by-step methodology. The end of the semester student evaluations included comments, such as this student's:

> "Less content – more explanation. More help sessions, possible written step-by-step instructions for programs and a frequently asked questions handout. More visual aids, such as handouts."

Another student commented that he would have preferred the methodology utilized by the adjunct faculty and stated:

> I observed several other ETC 447 classes while working on class projects and noticed a big difference between my class and the others. Our class spent more time utilizing trial and error to learn material. Other classes spent time moving through material step by step. Our class could have benefited from a little more step by step attention to limit confusion."

These comments suggest that many students desired direct instruction. One student even suggested that he wanted more lecture time by stating; "Dr. T. is cool, but there may have been a little bit too much workload for the amount of lecture time used." Another student seemed to miss the point of "constructionism" entirely. "I would like to have this course be more classroom oriented. I will never build a computer program [lecture series project] again in my life. I can't think that this course is relevant to future teachers."

Not preferring or not understanding the learning methodology that was employed and modeled in this learning environment may have been frustrating, as this student stated: "This course forced me to learn a lot about computers. I had to figure out my programs by myself and this caused much frustration."

Furthermore, cooperative leaning activities are built into the course through team projects and the faculty encourages peer support and collaboration. However, this was seen as not getting the information from the instructor. Indeed, this student commented:

> "It was difficult to get assistance from either the teacher or the GA. Most of the teaching was done by the few students who actually understood what and how to run the programs, which they learned on their own or in other classes."

This student commented that: "Some things taught in the 1st part of the semester, I forgot later. It would be helpful if a handout of some type was given."

Even though these comments indicate that many students would have preferred more direct instruction and that they were frustrated, they also indicated that they learned a great deal. This student stated: "I probably have learned more about computers and technology in 3 months of this class than I have in 21 years of life." Another stated: "The course is a little overwhelming sometimes, but I really learned a lot." Interestingly, this student stated: "This was a great course that really helped me further develop my computer skills."

## Conclusions

Conclusions drawn from this study suggest that currently learners may not have enough experience learning with the integration of technology to feel comfortable to take responsibility for this type of learner-centered environment. The participants of this study, especially in the professional development group, may never have been taught from a constructionist paradigm. This could lengthen the time it takes for these learners to feel comfortable with having their instructor in the role of a facilitator of learning, rather than the giver of knowledge. For example, the professional development group presented a challenge for the NAU faculty not because of the lack of technology skills among some participants, but because of their lack of self-confidence of being an *expert*. Furthermore, the university pre-service students indicated their desire for more direct instruction and even commented on their frustration with having to "figure out the programs." However, for those students who saw themselves as experts, the learning didn't appear to be as frustrating. For example, the student who thought that the course was "great" and that it helped her "*further develop*" her computer skills. This indicates that she believed she already had some computer skills. Perhaps, her awareness of her self-efficacy gave her the self-confidence to explore and better supported her engagement in this type of learning environment.

This brings up new questions regarding the maturity or level of background knowledge needed to understand the concept of the integration of technology within the PreK-12 classroom. What does this say about how we prepare our future teachers or provide professional development for our in-service teachers, specifically in the complex area of computer technology? Perhaps as the professional development group member who stated, "Maybe we need to consider a different term for "expert," we educators need to help our pre-service and in-service teachers re-define expertise and try to instill greater self-confidence in their ability to learn the integration of technology into instruction. Although these learners may have not felt comfortable, they did indicate that they learned. Indeed, the professional development group even indicated that they would probably integrate technology into their teaching practice in a similar fashion. Because of the rapid development of computer technology, expert knowledge is constantly changing. Therefore, learners must continually learn by using their current skills and knowledge to explore new programs and technologies. Educators should focus on helping learners build upon their self-efficacy to support their inquiry within this new paradigm.

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